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(57) Utility Model Registration Claims

A hollow fiber module in which both ends of a great number of hollow fibers are fixed by bonding and in which the ends of the hollow fiber bundles are fixed, characterized by the fact that the lower end of the module thus fixed by bonding is sealed and by the fact that slits opening directly into the module are set in the fixed part of the lower hollow fiber bundle and that the great number of hollow fibers installed in the casing can be vibrated by gas introduced through the slits.

Detailed Explanation of the Invention

Industrial Field of Application

This invention relates to a hollow fiber module that is designed to facilitate the removal of pollutants, such as colloids, adhering to the outer surface of hollow fibers when raw water containing colloidal substances such as metal colloids is filtered.

Prior Art

The use of a hollow fiber module to filter raw water containing colloidal substances such as metal colloids under external pressure has been known.

Problems that the Invention is to Solve

When the aforementioned hollow fiber module is used to filter under external pressure, it has the defects that the volume of filtered water is reduced by the colloids adhering to the outer surface of the hollow fibers and that the hollow fibers have a shortened life. There is the problem that although back-washing is carried out to remove the colloids adhering to the outside surface of the hollow fibers, the back-washing does not achieve satisfactory results.

This invention aims to solve the above defects and problem by removing the colloids adhering to the outer part of the hollow fibers through a simple structure.

Means of Solving the Problems

As a result of investigating various means and methods of preventing the volume of filtered water from being reduced when doing complete filtering with a hollow fiber module under external pressure, the inventor discovered that it was effective for removing colloids adhering to the outer surface of the hollow fibers, to put slits opening directly inside the module by perforating the fixed part in the hollow fiber bundle fixed end part to which the hollow fibers in the lower end of the hollow fiber module are bonded. When the volume of filtered water was reduced as described above, gas or liquid containing gas was introduced through the slits opening directly inside the module by perforating the above hollow fiber fixed end part, and the gas or liquid containing gas introduced rose along the hollow fibers. In other words, the hollow fiber module of this invention being a hollow fiber module in which both ends of a great number of hollow fibers are fixed by bonding and in which the ends of the hollow fiber bundles are fixed, is characterized by the fact that the lower end of the module thus fixed by bonding is sealed and by the fact that slits opening directly into the module are set in the fixed part of the lower hollow fiber bundle and that the great number of hollow fibers installed in the casing can be vibrated by gas introduced through the slits.

Action

Because the lower ends of the great number of hollow fibers which have both ends fixed by bonding are sealed and the module has slits opening directly into the module in the fixed end part of the hollow fibers that have their lower part sealed and the hollow fibers are installed in the casing so that they can be vibrated by gas or liquid containing gas introduced through the slits, colloids adhere to the outer surface of the hollow fibers bringing about the lowering of the volume of filtered water when raw water containing colloidal substances such as metal colloids are fully filtered under the external pressure method. In this case, when gas or liquid containing gas is introduced directly into the module, the introduced gas rises along the hollow fibers while causing the hollow fibers to shake, and so the colloids adhering to the outer surface of the hollow fibers are removed.

Working Examples

This section describes working examples of this invention based on drawings.

1 is the casing. 2, 2, 2 are hollow fibers. The required number of hollow fibers 2 form bundles, and these are bundles. Both ends of the hollow fibers 2 of these bundles are fixed with bonding agent 3, and become the hollow fiber fixed ends 4. The upper end of the hollow fibers 2 is fixed with the aforementioned bonding agent 3 but is open, and the lower end is sealed with filler. 5 is a slit for introducing gas or liquid containing gas opening between the large number of hollow fibers 2 directly by perforating hollow fiber fixed end part 4 on the lower end of the hollow fiber bundle with the sealed end. The large number of hollow fibers 2 bundled as described above form the vertical hollow fiber module by being put together in casing 1 so that they can be vibrated.

6 is a nozzle leading to the introduction of raw water connected to the lower part of casing 1. 7 is a filtered water outlet connected to the upper part of casing 1. 8 is an ejection outlet for filtered water during back-washing. 9 is an ejection outlet for gas when gas is introduced. The pipes connected to the respective ejection outlets 8 and 9 (not illustrated) have solenoid valves controlling the discharge.

When full filtering is carried out using the external pressure method with the hollow fiber module used vertically, the flow through pipes connected to filter liquid ejection outlet 8 and gas ejection outlet 9 is stopped with solenoid valves. Therefore, raw water containing colloidal substances such as metal colloids is introduced under pressure into casing 1 through nozzle 6 connected to the lower end of casing 1. The raw water introduced is filtered by hollow fibers 2 and becomes water not containing colloids, and rises within hollow fibers 2, and is extracted from the upper end of the open hollow fibers 2 via nozzle 7. When operations continue the filtering effect through the external pressure method, colloids adhere to the outer surface of hollow fibers 2 and the volume of filtered water decreases. When the volume of filtered water is seen to decrease in this way, gas containing air or liquid containing gas is introduced through the slits 5 formed by perforating the fixed end part of the hollow fibers bonded to the lower sealed end

part of hollow fibers 2 and opening directly into the module, and the solenoid valves connecting to the gas ejection outlet 9 are opened.

The gas introduced through the slits 5 rises along hollow fibers 2 while vibrating the various hollow fibers 2. These vibrations remove the colloids adhering to the outer surface of hollow fibers 2, bringing them down, and the gas is extracted through gas ejection outlet 9. The colloids brought down are taken out of the module system through the aforementioned slits 5. In addition, if the colloids cannot be removed satisfactorily just with the gas or liquid containing gas introduced through slits 5, back-washing is carried out through upper nozzle 7 in the module, but in this case, the liquid for back-washing is taken out by opening the solenoid valve of the pipe connected to the filtered liquid ejection outlet 8 used for back-washing. Next, the colloids can be completely removed by combining this with back-washing again with gas.

To remove the colloids adhering to the hollow fibers 2, it is effective to set up as many slits 5 as possible opening directly into the module by perforating the hollow fiber fixed end part 4 at the lower end because the slits force the gas or liquid containing gas to rise along the surface of hollow fibers 2 by introducing gas or liquid containing gas through slits 5. It is also effective for the gas to have uniform contact with hollow fibers 2. However, if there are too many slits 5, the membrane surface is reduced. Therefore, for practical purposes, it is desirable to have around 2 to 6 slits 5. Figure 2 a. to e. shows examples of their shapes. Rectangular and cylindrical shapes or combinations of these work well, and in fact any shape will do. The slits 5 shown in Figure 5 a. are combinations of T shapes. The slits shown in Figure 5 b. are combinations of cylindrical slits 5, and the slits shown in Figure 5 c. and d. form a cross. Figure 5 e. shows slits 5, forming a radiating shape.

The 10 in the Figure are protective nets set in the upper and lower hollow fiber bundles to prevent hollow fibers 2 being sucked in to filtered liquid ejection outlet 8 or gas ejection outlet 9 by the flow of liquid.

Effects

In the hollow fiber module of this invention, the lower end of a great number of hollow fibers is sealed, and slits are formed opening into the module directly by perforating the fixed end of the hollow fiber bundles on the sealed lower end. Therefore, colloids adhere to the outer surface of the hollow fibers, and when the volume of filtered water is reduced, gas or liquid containing gas is introduced. The introduced gas rises along the hollow fibers because the lower end of the hollow fibers is sealed, and the colloids adhering to the outer surface of the hollow fibers can be removed. As a result, the invention has the outstanding practical effects such as recovering the volume of filtered water and extending the life of the module.

Brief Explanation of Drawings

Figure 1 is a conceptual vertical-section diagram of part of the hollow fiber module of this invention. Figure 2 a. to e. is a conceptual diagram showing the shapes of slits opening into the fixed end part of the hollow fiber bundles at the lower end of the hollow fiber module of this invention.

1: Casing
2: Hollow fibers
4: Fixed end part of hollow fiber bundles
5: Slits
6: Nozzle introducing raw water
7: Filtered water outlet nozzle
8: Ejection outlet for filtered water during back-washing
9: Ejection outlet for gas when gas is introduced
10: Protective net

Figure 2

Figure 1

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DECLARATION

I, the undersigned Margaret Ann Crute of 87 Catherine Street Leichhardt, New South Wales say that I have registration at NAATI Level III for translation from Japanese to English, that I have translated Japanese Patent Kokoku Number S63-38884 and that the translation of this document is to the best of my knowledge and ability true and correct.

Leichhardt, 8 February 2001

Translator's signature Margaret Crute

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